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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 6] [1917

XXI.—ENNEAPOGON MOLLIS IN ASCENSION ISLAND.

O. Stapf.

(With Plate.)

Sir Joseph Hooker in his "Lecture on Insular Floras" gives the following description of Ascension and its vegetation:—

"St. Helena has been called a barren rock, but it is a paradise as compared with Ascension, which consists of a scorched mass of volcanic matter, in part resembling bottle glass, and in part coke and cinders. A small green peak, 2800 feet above the sea, monopolises nearly all the vegetation, which consists of Purslane[1], a grass[2], and a Euphorbia[3] in the lower parts of the island, whilst the green peak is clothed with a carpet of ferns, and here and there a shrub[4], allied to but different from any St. Helena one. There are nine ferns, of which no less than six differ from those of St. Helena, and three of them are entirely confined to the islet." This account takes only the endemic vegetation into consideration. To it has to be added a small number of plants which have more or less established themselves since the island has been inhabited and attempts at cultivation have been made. Large parts nevertheless have remained an absolute desert, especially along the coast and the lower parts generally. In June of this year, however, a remarkable change has been brought to our notice by the Director of Victualling, Admiralty, who sent to the Director a copy of a letter from the Farm Superintendent, Ascension Island, together with a specimen of a grass and the photograph here reproduced. In this letter the writer says: "You will be interested to know that a new grass has suddenly appeared in great abundance on the lower parts of the island. It first appeared to windward of the plain which the wide-a-wakes (sooty terns) frequent during their periodical visits, and has spread from there by the prevailing south-east trade wind to the Garrison

[1] *Portulacca oleracea*, L.
[2] *Aristida adscensionis*, L.
[3] *Euphorbia origanoides*, L.
[4] *Hedyotis adscensionis*, DC.

(5069.) Wt. 152—699. 1,125. 10/17. J. T. & S., Ltd. G. 14.

three or four miles on. It has quite altered the appearance of Garrison and the intervening country, and the horses and mules are being turned out to graze on it. I have made a small stack of hay on 'Wide-a-wake,' to test it as such, and many tons might have been put up if we had known it was coming and had been prepared for it.

"Whether the grass is a perennial and really useful remains to be seen; but the animals are extremely fond of it now. It is seeding freely, and should it grow again at any future time after favourable rains a large amount of hay might be made. It is climbing up the craters and turning them from red to green hills.

"I am posting with this a small piece of the grass as a specimen, and if you would kindly ask the Kew authorities how they class it I should be most pleased to hear their decision.

"The specimen is a short piece, but where the ground is better it grows 3 feet in height. It also grows on the brackish places which most things object to."

The grass has been determined as *Enneapogon mollis*, Lehm. (also known as *Pappophorum molle*, Kunth). It had not been recorded from Ascension before, but was known to occur on the coast of Angola and in Great Namaqualand, from which region it extends through the Kalahari Desert to Bechuanaland and Griqualand. It also inhabits the Sudan, parts of Abyssinia, Eritrea, and Somaliland and has been collected in Madagascar and once in the Punjab. It appears to be annual, as pointed out by Chiovenda (in Ann. Istit. Bot. Roma, viii. 358, sub *Pappophorum abyssinicum*), but the occasional presence of tardily flowering innovation shoots sometimes gives it the appearance of a perennial. It is a typical desert grass. It grows in the palm groves of Loanda Island, according to Welwitsch (Cat. Afr. Pl. Welw. ii. 229, under the name of *E. abyssinicus*, Rendle), in dense masses and covers wide areas, and Gossweiler says of it, in a note accompanying one of his specimens, that around the town of Loanda—sandy arid soil—it springs up after rainy days. Like most annuals, it shows great fluctuation as to size according to the fertility or sterility of the soil and the water supply. Particularly robust specimens, collected in the Hissar District in the Punjab in 1886—possibly as a casual introduction—were described as a new species, *Pappophorum robustum*, Hook. f. The dispersal of the grains is much aided by the extreme lightness and the feathery awns of the florets, which on maturity become detached and, with the grain tightly enclosed in them, may be carried over wide distances by the wind or by birds and other animals to which they would readily adhere. They would cling equally well to clothing or packing materials, and thus be dispersed by human agency. Once established under suitable conditions there seems to be no reason why the grass should not reproduce itself regularly, although in an excessively arid climate the grains might remain dormant in rainless years. No precise information concerning the economic value of the grass is available, but there is little doubt that it would be a valuable asset in any arid country. It may be remarked in support of this contention that

Major R. Gordon, of Lochinvar Monze, North Rhodesia, found the similar and nearly allied grass *Schmidtia bulbosa*, Stapf, a most valuable fodder for his horses when during the South-West African campaign of 1915 they had to subsist on it almost exclusively during long forced marches. As *Schmidtia* is a perennial grass and grows under similar conditions to this *Enneapogon*, it might be worth while to try to establish it in Ascension Island.

A similar photograph to that reproduced and a specimen of the grass has also been received from Ascension through a private correspondent, who writes: "Rain is a very rare occurrence, but some months ago they had most bountiful showers, and immediately the island blossomed into green verdure." In a further letter the writer, who knows the island well, states that he believes the recent rain is the first within living memory, and that he has never seen a blade of grass on the island except on the mountain tops, where there is almost a perpetual mist.

XXII.—BARK CANKER IN HEVEA BRASILIENSIS.

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Phytopathological problems in connection with *Hevea brasiliensis* present many curious features. Bark canker caused by *Phytophthora Faberi* has been considered the most serious disease in Java by Rutgers (7) since 1912, and Petch (4) in Ceylon obtained successful inoculation experiments on rubber with *P. Faberi* taken from diseased Cacao pods in 1910. Bark affections, as described from Java and Ceylon, were not, however, reported in Malaya before 1916, and it was not until late in 1916 that serious outbreaks were noted. During 1916 Dastur (3) carried out extensive observations on *P. Faberi* in Burma, and the conclusions drawn from his laboratory experiments are interesting when taken in conjunction with Malayan observations.

P. Faberi on Cacao and Cross Inoculations on Rubber.

Rorer (6) settled the question of the cause of Cacao canker by careful inoculation experiments, proving that *P. Faberi*, Maub., was undoubtedly responsible. Petch (loc. cit.) in 1910 following on Rorer's work, inoculated ten *Hevea* stems with *Phytophthora* spores obtained from diseased Cacao fruits and three more by inserting pieces of diseased Cacao pods in wounds. Six of these thirteen inoculations gave definite infections, and he concluded that canker and pod disease of *Hevea* are caused by the same *Phytophthora* which is responsible for the stem canker and pod rot of Cacao—viz., *Phytophthora Faberi*, Maub.

These observations tended to disprove Carruthers' (2) conclusion that *Hevea* canker was caused by a species of *Nectria*. The matter was left in an unsatisfactory state, for the inoculations carried out by Petch were too few in number, and objections could be raised against the method adopted. Rutgers (loc. cit.),

working independently in Java, carried on the work much further, and his conclusions supported those of Petch as to the cause of bark canker of *Hevea brasiliensis*.

Investigations in Java by Rutgers.

Rutgers investigated bark canker of *Hevea brasiliensis* in great detail and contributed valuable information regarding the various manifestations caused by *Phytophthora Faberi* on diseased bark. He showed by large numbers of inoculation experiments that the symptoms manifested depend largely as to whether untapped or renewing bark is attacked. The infection takes place on the tapping cut, and if the fungus enters the renewing bark, 'Streepjeskanker' or Line-canker (Form A) is the result; if the untapped bark is affected 'Vlekkanker' or Spot-canker (Form B) is observed.

Rutgers describes his observations on Spot-canker in detail B, C, D (loc. cit.):—

(B. Spot-canker):—The second acute form of canker is the appearance of moist, dark-red (sometimes reddish-brown or reddish-grey) spots in the bark, usually beginning at a cut. They are not visible till the outer cork of the bark is removed. If the bark is removed we find, not the green colour of the outer living bark (phellogen), but a black layer, and below it a damp dirty-red canker spot is found sharply defined from the surrounding healthy yellow bark. If these diseased spots are not treated in time they reach a great size and kill the bark down to the wood, while in bad cases the whole tree may be ringed. The diseased spots yield no latex when cut, though the healthy surrounding tissue does sometimes yield an unusual quantity.

(C). Sometimes the red canker spots described under (B) have only a limited spread, but a discoloration is found in the inner bark close to the cambium. This form is usually less striking than Form (B) but the infection proceeds further. It appears on the cut in dirty brown or grey lines and spots, sometimes also as a brown layer in place of the cambium. A typical mark of this form of canker is the complete drying up of the cuts within the discoloured area.

(D). If the cases included in (C) are not treated they may lead to very noticeable swellings, *i.e.*, "Burred trees." The grey lines and spots are dead cells or latex receptacles with coagulated latex, in the midst of living bark tissue. Under certain circumstances not yet known these dead cells cause the surrounding cells to split up and produce a secondary cambium that forms wood around the dead cells. This working of the secondary cambium leads to the formation of lumps of wood (burrs) in the bark, originally quite loose from the central wood of the trunk, and differing in form according to the number and position of the dead cells which cause them. This wood sometimes appears in small round bullets like the "peas" found on healthy trees; sometimes from the beginning large plates of wood are formed. If these wood formations are not treated in time they continue to increase in size and thickness and may develop alarming dimensions. This is the origin of the trees

deformed by great bark swellings which can be found on almost any old *Hevea* estate. As the swelling increases in size the bark bursts and displays hollows in which sometimes considerable quantities of latex are coagulated; whole sheets of rubber are occasionally found under such deformed bark. The yield of latex is exceptional at this stage, but tapping is almost impossible.

Rutgers's inoculation experiments showed that *Phytophthora Faberi* attacks the renewing bark, forming small vertical black lines above the tapping cut. This is the Line-canker (Form A), to be described below.

Petch's Observations in Ceylon.

Petch has studied *Hevea* canker in great detail in the field, and his final observations on the attacks of *Phytophthora Faberi* in the untapped bark agree with those of Rutgers. An affection of renewing bark was noted by him, the description of which agrees in all respects with that of (Form A) Line-canker of Java; but he considered this decay of the renewing surface to be caused by an excess of moisture on the layer exposed to the rain during tapping, and not to any pathogenic cause, as he failed to reproduce the decay by means of organisms found in the decayed bark. Later Bryce (1) stated that this decay in Ceylon could be ascribed to physiological causes, though Dastur had proved that similar symptoms described as Black Thread in Burma were caused by *Phytophthora Faberi*.

Dastur's Investigation in Burma.

In 1916 Dastur (3) published two articles recording his observations on a decay of renewing bark of *Hevea brasiliensis*. The symptoms are locally known as Black Thread and are similar to those described by Rutgers as (Form A) Line-canker caused by *P. Faberi*, and to those shown in the rotting of the renewing bark in Ceylon; the cause of which Petch did not determine. The symptoms are described as follows by Rutgers:—

A. Line-canker:—The easiest to recognise are the vertical dark lines in the new bark over the cuts. In unusual rain and damp this form of canker sometimes appears as an epidemic on a large number of cuts. In the bark healing over the cuts, fine vertical black lines appear, beneath which a broader discoloration penetrates to the wood. These black lines, which are often numerous on one cut, soon become longer and broader and appear in the new bark as black, sunken, rotten spots, sometimes with grey fungus on the surface. If tapping is continued they spread and coalesce and the whole of the new-formed bark rots away. It may spread inwards into the untapped bark below the cut. If there is continued dry weather it ceases to spread. To begin with, the yield of latex in this form of canker is normal; later the affected cuts cease to yield.

In a severe drought different symptoms may appear which may lead to confusion. Wounds appear in the newly formed bark even with good tappers, who do not usually cut too deep. These are tapping wounds, as may be recognised from the fact that they follow the direction of the tapping. In dry weather it is not possible to tap as deep as in wet weather without wounding.

As Dastur states, this description clearly shows that Line-canker in Java is identical with Black Thread disease of *Hevea* in Burma, but he points out that it is not clear why Rutgers considers the two forms, *i.e.*, Form A and Form B (the latter including C and D described above) to be due to the same fungus, *Phytophthora Faberi*. For although he inoculated *Hevea* with *Phytophthora* obtained from Cacao and obtained the typical canker Form B in every case, yet when he inoculated *Hevea* with *Phytophthora* from *Hevea* he obtained the typical black vertical stripes of Form A. It is unfortunate that the *Phytophthora* found on *Hevea* has not been inoculated on Cacao either by Petch or Rutgers.

Diseases on Renewing Bark in Malaya.

Rutgers paid a short visit to Malaya during 1912 and reported, as a result of an inspection of burred trees, that Form D described above was present on Malayan plantations. This feature never assumed serious proportions and perhaps is now less noticeable than at the time of Rutgers's visit. Little attention was given to this manifestation. In 1916 two serious affections of renewing bark were under observation in widely separated districts of Malaya. One district is in North Perak, the other in the Negri Sembilan. Both districts are well inland, the affected estates being situated on undulating land.

Bark Canker (Black Stripe) in North Perak.

The symptoms of the N. Perak outbreak closely resemble those described for the Black Thread of Burma and the Line-canker of Java, but the blackening of the tissues along the whole cut as mentioned both by Dastur and Rutgers is seldom observed except in long neglected cases. The vertical black lines remain separate with an inch or two of healthy bark between the lines. The diseased tissue when cut into with a small gouge extends not only to the wood but penetrates deeply into it. Other observers have not recorded this penetration of the woody tissues; they simply state that it extends through the cambium into the wood without calling attention to the fact that this observation may be of fundamental importance in a consideration of treatment. In N. Perak, cases have been noted where there was no external indication beyond a small slightly discoloured spot, yet excision reveals the wood diseased to a depth of $\frac{1}{2}$ or $\frac{3}{4}$ of an inch with a vertical extension of one inch. The penetration in a radial direction must be very rapid, for cases have been examined showing discoloured wood to a depth of an inch which could only have originated from infections made seven to ten days previously if the infection takes place on the tapping cut. The fungus can be demonstrated in the discoloured wood at its deepest part. This radial penetration of the wood is so extraordinary that special attention was given to the progress of the fungus in the tissues. Dastur (3) states that the fungus seldom runs below the tapping cut in Burma though Petch and Rutgers record instances where the Black Stripe decay travels downwards to involve the untapped bark. These cases appear to be excep-

tional, but in N. Perak the fungus often progresses in the wood 1 to 2 inches below the cut. The penetration of the wood is as rapid in the vertical as in the radial direction, but there is little lateral growth. As a result the Black Stripes remain localised; the fungus appears largely confined to the medullary rays in its passage through the wood.

These observations, coupled with the fact that a species of *Phytophthora* was isolated from diseased wood taken at a depth of $\frac{3}{4}$ of an inch in the stem, are significant. Numerous isolations were made which all turned out pure cultures of the same species of *Phytophthora*. The isolation of *P. Faberi* from decaying bark on the renewing surface has presented some difficulty to previous observers and when attempting to prove the incidence of the disease they have utilised pure cultures obtained from diseased seed pods for inoculating experiments. Time would not permit a comparative study of the fungus to determine whether it agreed with the description of *P. Faberi* but it may be stated with some degree of certainty that a *Phytophthora* is responsible for the symptoms observed in N. Perak.

Bark Canker symptoms in Negri Sembilan.

The Negri Sembilan outbreak, though an infection of renewing bark, shows different symptoms to that in Northern Perak and if a determination of the disease depended on a comparison of external signs there would be justification for stating that two different bark diseases occur in Malaya. In this case there is practically no penetration of the wood; the active radial and vertical growth in the wood so characteristic of the N. Perak fungus is missing. Apart from the absence of Black Stripes the outbreak corresponds to Bark canker as described from Java and Sumatra. Pratt (5) in Sumatra describes bad cases in which "individual black lines are not apparent, the whole of the tapping cut turning black." He makes no reference to the disease pentrating into the wood. In Negri Sembilan the renewing bark is attacked, not in lines, but in patches just above the cut. The descent of the cut owing to tapping is usually more rapid than the downward growth of the fungus, so that after a few days a black, disorganised area of bark tissue is found covered with a greyish-white bloom running roughly parellel to the tapping cut. The greyish-white bloom is caused by a growth of saprophytic fungi, a species of *Cephalosporium* predominating. Dastur (3) says that in Burma the decaying bark is soon overrun by saprophytic fungi like *Fusarium, Cephalosporium* and *Spicaria*, especially the first. If the attack is neglected, the fungus spreads and the tissue down to the tapping cut becomes black and diseased.

Old cases never showed the fungus growing in the woody tissues except in the external elements, and black lines were never observed penetrating the wood, though another observer has seen indications of their presence. Isolation experiments carried out over several weeks before the writer's departure from Malaya on leave showed no indications of the presence of a *Phytophthora*.

Attention is directed to the differences in the nature of the two attacks. According to the descriptions from other countries of the activities of *P. Faberi* in the bark of *Hevea brasiliensis*, this fungus might be considered responsible for both Malayan outbreaks. The essential differences are such that the evidence practically justifies the conclusion that two different fungi are operating. In N. Perak a *Phytophthora* rapidly penetrates the wood in a radial and vertical direction with practically no lateral extension. Assuming the Negri Sembilan outbreak to be caused by the same fungus it is remarkable that under similar conditions, the fungus does not penetrate the wood, but is confined entirely to the bark, extending quickly in a lateral direction. Dastur has evidently met some difficulty in reconciling the available evidence to the view that the one fungus, *Phytophthora Faberi*, is responsible for the varied bark troubles in rubber in the Middle East.

He says (3) "It seems clear that we have in *Hevea* two different species of *Phytophthora* causing two distinct kinds of diseases instead of one fungus causing two distinct symptoms of one disease. Of these two different species one is *P. Faberi* which causes *Hevea* canker identical with that of Cacao as shown by the inoculation experiments of Petch and Rutgers; and the other species causes Streepjeskanker or Black Thread disease as seen from the inoculation experiments made by Rutgers in Java and me in Burma."

Malayan observations are important in the light of this statement. The writer had no opportunity of pronouncing upon the identity of the *Phytophthora* isolated from N. Perak specimens, but it would be interesting to know whether it agreed with *P. Faberi*, Maub. in order to test Dastur's conclusion. As far as the records go, there appears to be no previous case where the *Phytophthora* has been isolated in pure culture from the diseased tissues.

These observations are placed on record only to show investigators in other rubber-growing countries that the present position is most unsatisfactory, and that the subject calls for further patient investigation. Recommendations for combating the disease depend on our knowledge of the causal fungi and their *modus operandi*. Methods as recommended in Java have been tried in Malaya but were found to be valueless. Dastur does not seem convinced of the efficacy of measures previously recommended by other investigators and our advice in Malaya, where strenuous measures are necessary, has been generally to treat each individual case on its merits. Little progress can be expected until an investigation of Bark diseases in the different rubber-growing countries has been made by an observer with opportunities to investigate the problem in all places where Bark disease is prevalent. For Malayan plantations the question is a serious one as is indicated in the following article.

A more detailed account with measures adopted to combat the Malayan outbreaks has been written for the Agricultural Bulletin, Federated Malay States.

(1). Bryce, G.—Report of the Acting Botanist and Mycologist. Tropical Agriculturist, xlvii, No. i. 1916, p. 29.
(2). Carruthers, J. B.—Canker (Nectria) of Para Rubber (Hevea brasiliensis) Circs. & Agric. Journ. Roy. Bot. Gard. Ceylon, ii, No. 29, 1905, p. 445.
(3). Dastur, J. F.—Phytophthora sp. on Hevea brasiliensis. Mem. of the Dept. of Agric. in India. Bot. Series, Vol. viii, Nov. 1916.
(4). Petch, T.—Cacao and Hevea Canker. Circs. & Agric. Journ. Roy. Bot. Gard. Ceylon, v, No. 13, 1910, p. 166.
(5). Pratt, H. C.—Preventive Measures against Black Thread.—(Phytophthora Faberi). Agric. Bull. Fed. Malay States, Vol. v, Nos. 5–6, Feb. & Mar. 1917.
(6). Rorer, J. B.—Pod-Rot, Canker and Chupon-Wilt of Cacao caused by Phytophthora sp. Bull. of Trinidad Dept. of Agric. ix, No. 65, 1910, p. 91.
(7). Rutgers, A. A. L. & Dammerman, K. W.—Diseases of Hevea brasiliensis in Java. Med. van het Lab. von Pflantenziekten, No. 10, pp. 27–33.

XXIII.—THE SIGNIFICANCE OF DISEASES IN THE ECONOMY OF MALAYAN RUBBER PLANTATIONS.

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The fungus diseases of *Hevea brasiliensis* have been actively investigated during the last six years. The situation in Malaya, where rubber is practically the only agricultural product, lends itself to intensive research, and pathological investigations over several years have been confined to observations on *Hevea brasiliensis*. Much information has been gained regarding the action of fungi attacking rubber trees, especially since 1913, but it is only during the last twelve months that a statement regarding the ultimate effect of disease upon the economy of Malayan plantations could be made. The significance of the researches on fungus diseases of *Hevea brasiliensis* will be better realised if taken in chronological order.

At the beginning of 1913 when the writer reached Malaya the only serious troubles were those caused by the root fungus, *Fomes lignosus*, Klotzsch, and by White Ants. The die-back caused by *Diplodia cacaoicola*, P. Henn., had been investigated thoroughly by Bancroft (1) but this disease had never caused alarm on the plantations. During 1913 the chief feature on Malayan plantations was the rapid spread of Pink disease and the absence of bark diseases; the latter had been investigated in Ceylon by Petch and in Java by Rutgers, and shown by the latter to assume serious proportions on some rubber plantations in Java.

In 1914 Mr. F. T. Brooks was appointed Mycologist to the Department of Agriculture, Federated Malay States, and an energetic search into the cause and spread of Pink disease was started. Towards the end of 1914, Brooks established *Ustulina zonata* as the cause of a root and collar disease on *Hevea brasi-*

liensis. A vain search for bark diseases caused by *Phytophthora Faberi* was conducted throughout the year, but up to the end of 1914 when Brooks left for England there was no cause for uneasiness.

Investigations on the disease caused by *Ustulina zonata* were carried forward, and in 1916 serious attacks by this fungus were noticed. About the beginning of 1916, Belgrave (2), who was appointed Assistant Mycologist just before Brooks left, commenced investigations on a wet rot of *Hevea* roots, which appeared quite distinct from the dry root-rot caused by *U. zonata*. A preliminary statement of his work has been given (2) but the full account has not yet been published.

The following cases of serious attacks of root disease may be quoted:—(A) The Government plantation behind the offices of the Department of Agriculture at Kuala Lumpur carries about seven acres of 15-year old trees. A fair number of trees attacked by *Ustulina zonata* were known, but only one small group of six trees was known to be affected with wet root-rot. To obtain specimens and observe the disease below ground, this group together with the neighbouring trees, was opened up. It was obvious from the commencement that the subterranean spread of the disease was much greater than at first anticipated. The roots of two hundred and twelve trees were exposed and 40 per cent. showed diseased roots, largely caused by the fungus producing wet root-rot. The matter was so serious that at the request of the Advisory Committee to the Department of Agriculture, all the trees in the seven acres of old rubber had their roots exposed, and of the 700 trees in the whole area 20 per cent. showed diseased roots.

(B) Another illuminating case was noted a few months ago. A wind storm locally known as a "Sumatra" swept over a portion of one estate and numbers of 17-year old trees were blown over. Only three of these prostrate trees showed healthy roots, and these were without tap roots. A few of the fallen trees had previously been treated for *U. zonata*, but the great majority, which were not suspected to be suffering from root diseases, were found to have this fungus attacking the roots. A few cases of branch infections with *U. zonata*, and a few trees with wet root-rot were also found. When the place is cleared huge gaps must be left in the wind-swept area. The manager expresses his conviction that any other portion of the old rubber on his estate subjected to a similar storm would show a large number of unsuspected cases of root disease. These cases show the insidious spread of these root fungi on old rubber, and it is impossible to urge too strongly the necessity for immediate and strenuous measures to keep them under control.

The necessity for active sanitation measures in Malaya is apparent to all who have studied the accounts of these root-rots, but no justification existed for assuming that diseases of rubber need prove an active factor in inhibiting the development of Malayan plantations. In Malaya, diseases on the plantations have been effectively combated by growing more trees per acre than are absolutely necessary, at the same time avoiding over-

crowding. This results in a diminished amount of light and air, i.e., free ventilation, reaching the trees. This factor does not influence the spread of root-rot on old trees to an appreciable extent and if bark renewal is not interfered with, losses owing to root disease can be compensated for.

If free ventilation becomes necessary in the plantations this satisfactory method of allowing for diseased trees cannot be followed. Investigations in rubber-growing countries other than Malaya show that free access of light and air is one of the essential conditions in combating Bark diseases of *Hevea brasiliensis*. Bark diseases were practically unknown in Malaya up to 1916 and as long as serious bark affections were not reported the position could be considered satisfactory.

The previous article gives a short account of the serious outbreaks of Bark disease observed in Malaya in 1916. Treatment necessitates a vigorous thinning-out to the minimum number of trees per acre commensurate with profitable working. This number might be termed the "working number," for convenience.

Conditions for the spread of fungus diseases are probably more favorable in Malaya than in any other rubber-growing countries. The atmospheric humidity is always high; there is no pronounced dry season when disease-producing fungi lie dormant which enables planters in Ceylon and Java to control diseases, especially those of the bark, more easily. The plantations are opened from virgin jungle, and as a consequence there are large numbers of jungle stumps and logs left in the ground to encourage disease. The troublesome root-rots in Malaya all originate from rotting jungle timber and stumps. Thus countries like Ceylon and Java, where large acreages of rubber are grown on land which has been cultivated for several hundred years, have a considerable advantage, for the original jungle stumps and timber have long ago disappeared, and there is little chance of the root-rots appearing unless previous crops were attacked by the same fungi. Fungus diseases again are always most dangerous where there are large acreages under one crop, for no obstacles to the passage of spores exist unless jungle belts are interposed between the cultivated areas. In Malaya the whole of the peninsula is under rubber, and though jungle belts are provided they are not wide enough to be effective in preventing the spread of fungus diseases. Pink disease is a case in point; the fungus causing Pink disease reported from three small centres in 1912 had spread practically over the whole peninsula by 1914.

These facts are brought forward to support the view that there is every chance of Bark diseases spreading and becoming general throughout Malaya, and to indicate that the experiences of Malayan planters are likely to be different from those of Ceylon and Java. Experience obtained in the latter countries cannot be quoted as necessarily applying to Malaya.

Until the discovery of bark diseases Malayan plantations could compensate for disease losses by keeping more than the "working number" of trees per acre. This position is now untenable

for the conditions for the spread of disease are so favourable that we may expect bark diseases to become general in the peninsula. Then if the root-rots are active—and these are already very generally distributed—the number of trees per acre may be so reduced that the best results will not be forthcoming, in fact, may make all the difference between profitable and unprofitable working.

Competition may now be considered. Plantation rubber reigns supreme, though there are possibilities of a cheap synthetic rubber. A great demand for rubber may be anticipated after the war, which will stimulate enquiry into the synthesis of rubber, and much activity may be expected in this direction. A commercial synthetic rubber may possess intrinsic properties which will make it valuable in the arts and manufactures, but if proper foresight is used to develop the plantations along scientific lines plantation rubber should never fear competition from the synthetic product.

The menace to the present plantations is disease.

In Malaya the question is specially serious. "The menace of disease in Malayan plantations is still potential, but it may prove the limiting factor in the development of the plantations if a serious competitor arises. If preventive measures are not undertaken the menace may become dynamic and prove the ultimate ruin of Malayan plantations."

The researches conducted in Malaya have impressed practical men in touch with the work of the Department of Agriculture. The need for sanitation measures is generally recognised, and the planters who disbelieve in their necessity and still endeavour to refute the idea of disease becoming a serious matter are few, an attitude very different to that recently held. Active clearing work is in progress on most plantations which can spare money and labour. The methods recommended to combat diseases of rubber in Malaya can be found in the special bulletins issued by the Department of Agriculture, and this article is intended as an introduction to suggestions which should be taken up and vigorously supported by institutions or by influential men interested in the rubber plantations of the Middle East.

To guard the future of the Malayan industry investigations along two lines, practically untouched up to the present, are of first importance. In the first place, a physiological investigation is needed to discover the role played by the latex in the metabolic processes of the plant, and also to ascertain in what measure the extraction of latex interferes with the full development of the tree. An investigation of this nature should provide information required to settle many controversial matters regarding tapping methods and should lead to an intelligent view of planting, which would supersede the present haphazard methods. The second line of investigation is that of seed selection, not only with the view of obtaining better yielding trees but also with the object of raising a strain of stronger and hardier trees, which would be more resistant to disease. Intelligent men interested in the rubber industry realise the necessity for immediate researches along these two lines. The outstanding ques-

tion, however, is largely one of the proper ways and means to reach the desired end. Both lines of investigation are purely scientific as regards their methods, and could best be carried out under the control of a properly organised Government Department which would ensure that the investigators could pursue their researches without interference from those interested only in obtaining immediate practical results.

(1). Bancroft, C. K.—Die-back fungus of Para Rubber and of Cacao. Bull. Nos. 9 & 14; Dept. of Agr., Fed. Malay States.
(2). Belgrave, W. N. C.—Root disease of Plantation Rubber in Malaya. Agric. Bull. Fed. Malay States, Vol. iv, No. 11, Aug. 1916.

XXIV.—THE PRESERVATION OF LEAFY TWIGS OF THE BEECH.

L. A. Boodle.

As the autumn colouring of the common beech shows some pleasing shades, such as golden-brown and chestnut-brown, leafy twigs of this tree with autumn tints are sometimes used for indoor decoration, the cut ends of the specimens being kept in water. After a week or two the leaves usually begin to crumple or to fall. Shrivelling of the leaves naturally takes place much sooner if the twigs are not supplied with water.

Some commercial value might attach to the preparation of specimens by an easy method of treatment which would make it possible to keep them without water while preserving the natural appearance of the leaves and giving them a colour like that of an autumn tint. A suitable method appears to have been devised, since twigs of beech with brown foliage, treated so as to keep the leaves from shrivelling, are sometimes offered for sale at shops. On examining one such specimen it was found to have been treated with some hygroscopic substance, while the brown colour was due to a dye, the twig having been gathered when the leaves were still green.

Some experiments have been made with the object of finding an easy method of obtaining a similar result. In these experiments calcium chloride was tried as a hygroscopic agent to prevent withering, and the possibility of using it successfully has been demonstrated.

The material experimented on consisted of large and small freshly cut beech twigs bearing green leaves, and was gathered in September, 1916. A series of experiments was made by placing the cut ends of the twigs in a watery solution of calcium chloride and leaving them for some days, the lower ends being trimmed every day or two, so as to present freshly cut surfaces to the liquid. Different strengths of solution were tried, and the treatment was continued for three, seven, or eleven days. Some of the specimens were exposed to bright sunlight for several hours during their treatment, while others were kept where only diffused light could reach them.

The results show that permeation of the internal tissues of the leaves with calcium chloride can be obtained by this method. The action of the treatment may be explained as follows: The solution is at first drawn up to replace the water lost by the transpiration of the leaves. Then death of the leaf-tissues occurs sooner or later after calcium chloride solution of a certain strength has reached them. An upward current of the liquid may, however, continue for some time after the leaves have been killed, especially if a weak solution is being used and if the specimens are exposed to sunlight.

Four strengths of calcium chloride solution were tried, having specific gravities of 1·05, 1·1, 1·2, and 1·4,* the strongest of these representing a nearly saturated solution at 60° F. The liquids were prepared with the aid of a hydrometer, and were filtered before use.

The best result as regards resistance to withering was obtained with the two stronger solutions (sp. gr. 1·4 and 1·2), the treatment being continued for a week with exposure to sunlight for some hours. The specimens treated in this way were in good condition after being kept for six months, and showed only slight curling of a few of their leaves.

Experiments with the weaker solutions were less successful, but were not sufficiently numerous or varied to prove that weak solutions are unsuitable. A branch of copper beech was treated with 1·05 solution for eleven days, and remained well preserved for a considerable time. After six months most of the leaves showed slight curling, though not enough to spoil the appearance of the specimen. One or two twigs of the common beech, similarly treated, were still less successful, as the leaves showed decided crumpling after a few weeks.

The length of time required for the treatment with a given strength of solution will depend partly on the dryness of the air and the degree of illumination, and probably to a great extent also on the nature of the specimen. Thus the sun—or shade—character of the leaves and the season at which the twigs are cut are presumably among the particulars concerned. In view of the uncertainty attaching to the length of time required, it is probably best to continue the treatment until waterlogging of the leaves is attained, or even rather longer. The waterlogged condition is easily recognised by the transparent appearance of the leaves. Exposure to sunlight is also recommended, as it was found to give the leaves a brownish colour, similar to an autumn tint, thus making dyeing unnecessary, unless other tints are desired.

In the case of the specimens treated with the two stronger solutions the treatment was continued for at least a day after waterlogging was observed. An exudation of liquid appeared on the lower side of the leaves of these specimens a day or two after the treatment with calcium chloride had been stopped. The twigs were therefore left a few days longer, then rinsed in

* In the case of the weaker of these solutions, the liquid increased its concentration to some extent during the experiment, as the vessels containing it were not covered, and evaporation took place.

water, and roughly dried by pressing between cloths. After this no further exudation was produced.

As the experiments described above were not numerous, it is desirable that others should be carried out. These might include the treatment of twigs collected earlier in the year than September. The addition of a poison to the solution of calcium chloride may also be recommended, as it was noticed that leaf-boring insects, which were present in some of the specimens, continued their burrows for a considerable time after the treatment with calcium chloride had been completed.

The three following experiments in treating beech twigs with calcium chloride were also made:—(1) The end of a twig was placed in a solution of calcium chloride in 50 per cent. spirit and left for some days, just as in the experiments with the watery solution; (2) a small specimen was kept immersed in a watery solution of calcium chloride for several days; (3) a specimen was boiled for a few minutes in the watery solution. These experiments did not give any satisfactory or even promising results, and were not repeated.

In addition to beech, twigs of hornbeam, bay-laurel, and elm were placed with their cut ends in a solution of calcium chloride. Fairly good preservation was obtained in the case of hornbeam, though the leaves assumed a rather dingy appearance, but the method appears unsuitable for bay and elm.

A few experiments were made in dyeing leaves of beech and hornbeam previously preserved by treatment with calcium chloride. The stain was applied by immersion in a watery solution of the dye, after which the leaves were rinsed in water. It was found, however, that if the leaves were left for an hour or two in the stain they were liable to curl on drying, probably owing to loss of calcium chloride. Hence, if rapid staining cannot be carried out, experiments might be made on the feasibility of dyeing specimens first and then treating them with calcium chloride.

XXV.—DIAGNOSES AFRICANAE: LXX.

1611. **Olax insculpta,** *Hutchinson ex E. G. Baker* in Cat. Pl. Talb. Nigeria, 124, nomen [Olacaceae-Olaceae]; affinis *O. Mannii,* Oliv., sed foliis latioribus plerumque ovato-orbicularibus nervis lateralibus profunde insculptis, floribus majoribus differt.

Frutex glaber; ramuli flexuosi, parce foliati, graciles, profunde sulcati. *Folia* ovato-orbicularia vel ovato-elliptica, basi leviter obliqua et brevissime cuneata, apice sensim acuminata, breviter acute mucronata, 10-15 cm. longa, 6-10 cm. lata, tenuiter chartacea, integra, viridia, basi trinervia; costa infra valde conspicua, basi circiter 1·75 mm. lata, apicem versus angustata; nervi laterales utrinsecus 5-6, supra profunde impressa, infra prominentes, intra marginem circiter 1 cm. conspicue juncti, junctūris arcuatis prominentibus; venae paucae, plerumque inconspicuae; petioli usque ad 5 mm. longi,

infra verrucosi. *Racemi* axillares, brevissimi, flexuosi, 5-6-flori; bracteae anguste lanceolatae, acute acuminatae, 1 mm. longae; pedicelli 1·5-2 mm. longi. *Alabastra* crasse elevata, 6 mm. longa. *Calyx* subcupularis, 0·5 mm. altus, marginem versus submembranaceus, leviter undulatus vel denticulatus. *Petala* 5, linearia, apice cucullata, 7 mm. longa, 1 mm. lata, carnosa. *Stamina* perfecta 3, imperfecta 8; filamenta crassa, petalis paulo breviora; antherae ellipsoideae, 1·5 mm. longae. *Discus* crassus, annularis. *Ovarium* ovoideum, basi triloculare; stylus 2 mm. longus.

Tropical Africa. Southern Nigeria: Oban district, *Talbot* 1334.

1612. **Pteleopsis obovata,** *Hutchinson* [Combretaceae-Combreteae]; species foliis late obovatis distincta.

Arbor 10-20 m. alta; ramuli cinerei, cortice glabrescente lenticellato, juniores rufo-pubescentes. *Folia* pauca, obovata, apice emarginata, basi breviter cuneata, 1·5-2·5 cm. longa, 1·2-1·7 cm. lata, tenuiter chartacea, infra delicate reticulata, utrinque costa rufo-pubescente excepta glabra; nervi laterales utrinsecus circiter 7, infra distincti; petioli 1-1·5 mm. longi, rufo-pubescentes. *Racemi* terminales, capituliformes; pedunculi 0·5-1 cm. longi, rufo-pubescentes; bracteae lineares 1·5-2 mm. longae, longe ciliatae; pedicelli gracillimi, usque ad 0·7 cm. longi, glabri. *Receptacula* cupularia, 1 mm. longa, extra glabra. *Calycis* lobi triangulares, fere 1 mm. longi, intra pubescentes. *Petala* spatulata, unguiculata, 1·5 mm. longa, 1 mm. lata. *Stamina* 10; filamenta 2·5 mm. longa, glabra; antherae late ovoideae, 0·5 mm. longae. *Ovarium* elongatum, glabrum. *Fructus* elliptico-oblanceolatus, complanatus, alatus, glaber, 2-2·5 cm. longus.

Tropical Africa. Portuguese East Africa: Msalu River, timber tree 50-60 ft. high, *Allen* 72; Msalu River Mouth, Jan. 12, *Allen* 156; Madanda forest, Oct., shrub or small tree, vernacular *Moaza*, *Dawe* 449.

1613. **Phyllanthus leonensis,** *Hutchinson* [Euphorbiaceae-Phyllantheae]; affinis *P. alpestri*, Beille, sed ramis glabris, foliis lanceolatis plerumque longioribus differt.

Caules ut videtur e rhizomate orti, simplices vel superne parce ramosi, erecti, glabri, basin versus circiter 2·5 mm. crassi. *Folia* lanceolata, apice obtusa, basi cordata, 1·5-3 cm. longa, 0·6-1·2 cm. lata, chartacea, glabra, marginibus incrassatis recurvatis; nervi laterales utrinsecus 5-6, infra conspicui; petioli nigri, verrucosi, 1·5 mm. longi; stipulae deciduae, ovato-triangulares, acutae, 1-1·25 mm. longae, membranaceae. *Flores* dioici, ♂ fasciculati. ♀ solitarii. *Pedicelli* ♂ capillares, usque ad 4 mm. longi, glabri; sepala 6, subaequalia, obovata, 1 mm. longa, membranacea, glabra; disci glandulae fere contiguae, rotundatae, laeves; stamina 3; filamenta libera, 0·75 mm. longa; antherae ellipsoideae, loculis divergentibus. *Pedicelli* ♀ nutantes, 0·5-1·3 cm. longi, sub calyce incrassati;

sepala 6, ovata vel elliptica, obtusa, subcarnosa, 1·25-1·5 mm. longa, 0·75 mm. lata, glabra; discus crenato-undulatus; ovarium 6-lobatum; styli brevissimi, recurvati, bifidi. *Capsula* depressa, 6·5 mm. diametro, 6-lobulata, obscure reticulata, stylorum vestigiis coronata. *Semina* triquetra, laevia, pallide straminea.

Tropical Africa. Sierra Leone: Sendugu, June 22, 1914, *N. W. Thomas* 580.

1614. **Agrostistachys ugandensis,** *Hutchinson* [Euphorbiaceae-Crotoneae]; affinis *A. africanae*, Muell. Arg., sed receptaculis ♂ glabris (nec villoso-pubescentibus), styli ramis e basi reflexis et breviter 2-lobatis (nec profunde partitis) differt.

Arbor parva (dioica?); ramuli floriferi circiter 1 cm. crassi, teretes, glabri. *Folia* magna, usque ad 4 dm. (plerumque circiter 2·5 dm.) longa, 0·8-2 dm. lata, repando-denticulata vel subintegra, chartacea, glabra, infra delicate reticulata; nervi laterales utrinsecus 16-20, a costa sub angulo latissimo abeuntes, marginem versus arcuati et evanidi, utrinque prominentes; nervi tertiarii numerosi, cum lateralibus angulo recto formantes, paralleli, tenues; petioli 2-3 cm. longi; stipulae caducae, terminales, lineares, acutae, circiter 2 cm. longae, glabrae. *Flores* axillares, ♂ dense fasciculati vel interdum subracemosi, ♀ in racemos axillares solitarios vel subsolitarios usque ad 6 cm. longos dispositi. *Flores* ♂ numerosi; pedicelli 0·6-1 cm. longi, 2 mm. supra basin articulati et pubescentes, superne glabri; bracteae 3, exteriore ceteras involventes late ovato-orbiculare integro coriaceo circiter 5 mm. longo et 4 mm. lato superne ciliolato, duabus interioribus oppositis cymbiformibus apice cucullatis et ciliolatis marginibus membranaceis; sepala 5, ovato-elliptica, 5-6 mm. longa, chartacea, apices versus extra breviter pubescentia; petala 5, sepalis fere aequilonga, oblongo-elliptica, glabra; discus glaber, crassus, lobulatus, inter lobulos staminibus numerosis insertis; filamenta circiter 5 mm. longa, antheris superne verrucosis; ovarium rudimentarium nullum. *Flores* ♀: bracteae pedicelli et perianthium ut in floribus ♂; discus hypogynus crassus, lobulatus, inter lobulos staminodiis subulatis insertis; ovarium tomentosum; styli e basi patuli, bilobulati, lobis acutis 1·25 mm. longis. *Fructus* non visus.

Tropical Africa. Uganda: Namalala forest, July 1913, ♂ fls., *Fyffe* 19; ♀ fls., vernacular *Munyabake*, *Fyffe* 64.

The discovery of a species of this genus in Uganda is very interesting in that it forms a connecting link in its geographical distribution—on the one hand between the West Coast of Africa (islands of St. Thomas and Fernando Po)—where *A. africana* occurs, and with India and the Malay Archipelago, where there are several species. Those who accept the classification of Pax in Engler's Pflanzenreich would include this new species in his genus *Pseudoagrostistachys*, founded on *A. africana*. Both these species differ from the Indian and Malayan in the absence of a rudimentary ovary from the male flowers.

1615. **Sapium Dalzielii,** *Hutchinson* [Euphorbiaceae-Crotoneae]; affinis *S. faradianense,* Pax, sed foliis multo angustioribus linearibus vel lineari-lanceolatis obscure denticulatis differt.

Caules erecti, e rhizomate lignoso gracile orti, e basi ad apicem foliati, subsimplices, graciles, sulcati, glabri. *Folia* linearia vel lineari-lanceolata, apice acuta, basi obtuse rotundata, 1·5-4 cm. longa, 0·3-0·8 cm. lata, uninervia, rigide chartacea, glabra, margine cartilagineo-incrassato minute denticulato basi utrinque 2-3-glanduloso; petioli 1-2 mm. longi, glabri. *Inflorescentiae* terminales, circiter 3-5 cm. longae, superne floribus masculis laxe dispositis, basin versus floribus foeminibus 1-2 instructae, utriusque sexibus brevissime pedicellatis, ad bracteis solitariis; bracteae trilobatae, lobo centrali lanceolato-triangulari acuto 1 mm. longo, lobis lateralibus crassis carnosis glanduliformibus glabris supra concavis 1·25 mm. latis suborbicularibus. *Flores* ♂: Calyx profunde 3-lobatus, lobis ovato-triangularibus minute denticulatis glabris. *Stamina* 3; filamenta demum 0·75 mm. longa. *Flores* ♀ pedicello crasso brevissimo; calyx 3-partitus, segmentis late ovato-triangularibus dentatis vel dentato-serratis acute apiculatis. *Ovarium* glabrum; styli 3, recurvati, 1·5 mm. longi. *Capsula* delapsa tantum visa 0·8 cm. longa, minute verrucosa. *Semina* late oblongo-ellipsoidea, 5 mm. longa, 4 mm. lata, pallide straminea.

Tropical Africa. Northern Nigeria: Katsina Allah, June, *Dalziel* 749.

1616. **Myrica arborea,** *Hutchinson* [Myricaceae]; affinis *M.* Kandtianae, Engl., sed foliis basi truncatis et inaequalibus, inflorescentiis unisexualibus differt.

Arbor 6-9 m. alta; rami satis robusti, circiter 5 mm. crassi, sulcati, arcte puberuli et glandulosi; ramuli juniores dense foliati, fere tomentelli. *Folia* oblonga vel oblongo-lanceolata, ad apicem breviter mucronatum rotundata, basi plerumque truncata et inaequalia, 5-9 cm. longa, 1·2-3·2 cm. lata, rigide chartacea vel subcoriacea, plerumque dentata vel serrulata, rarius subintegra, utrinque (infra dense) glandulosa, ceterum glabra; costa infra prominens; nervi laterales utrinsecus 12-16, a costa fere subangulo 90° divergentes, marginem versus plerumque distincte bifurcati, tenues, utrinque prominentes; venae ultimae vix evolutae; petioli 4-6 mm. longi, glandulosi et breviter pubescentes. *Flores* monoici. *Spicae* ♂ axillares, plerumque petiolis duplo longiores vel in ramulos efoliatos longos racemosim dispositae; rachis sericeo-tomentella; bracteae latissime-obovatae, fere 2 mm. longae, submembranaceae, ciliatae, extra glandulosae et pubescentes; stamina circiter 6; antherae parce pubescentes. *Spicae* ♀ ad basin ramulorum juniorum dispositae vel axillares et petiolis duplo longiores; bracteae late triangulares, circiter 2 mm. longae, submembranaceae, extra glandulosae et leviter pubescentes, ciliatae; ovarium et squamae hypogynae pubescentes et glandulosae; styli complanati, lati, crebre verrucosi.—*M. salicifolia,* A.

Cheval. Monogr. Myric. 140, partim; Engl. in Mildbr. Wiss. Ergebn. Deutsch. Zent.-Afr. Exped. 178, partim, non Hochst.

Tropical Africa. Upper Guinea: Cameroons; Cameroon Mountain, 2300-2620 m., *Mann* 1263; 2185. Borders of forests on the Mannsquelle, *Mildbraed* 3409. Buea, *Deistel* 179.

1617. **Salix Hutchinsii,** *Skan* [Salicaceae]; *S. capensi,* Thunb., valde affinis, sed capsula angustiore in stylum fere 1 mm. longum gradatim attenuata et glandulis disci pedicello subaequilongis differt.

Ramuli juniores primo parcissime pubescentes, cito glabrescentes, purpureo-brunnei. *Folia* petiolata, anguste lanceolata vel oblanceolata, apice acuta vel acuminata, basi attenuata, integra vel interdum minute serrulata, 2-3·5 cm. longa, 6-10 mm. lata, tenuia, glabra, supra viridia, infra conspicue glauca; petiolus 2-5 mm. longus, glaber vel parcissime pubescens; stipulae minutae. *Amenta* ♂ desunt. *Amenta* ♀ 1-3 cm. longa, laxa, pedunculos breves foliosos terminantia; rhachis griseo-villosa. *Bracteae* late ovatae, obtusae vel subacutae, 2 mm. longae, basi fere 2 mm. latae, membranaceae, dense villosae praesertim ad margines, apice extra glabrescentes, cito deciduae. *Glandulae disci* 1 vel 2, posticae vel laterales, magnae, carnosae, pedicellum dimidio cingentes eique aequi-vel subaequilongae. *Pedicellus* circiter 1 mm. longus, crassus, glaber. *Ovarium* anguste ovoideum, 3-3·5 mm. longum, glabrum, in stylum distinctum fere 1 mm. longum gradatim attenuatum; stigma breviter crasseque 2-lobum. *Capsula* (immatura) anguste ovoideo-ellipsoidea, 4-5 mm. longa, 2-2·5 mm. lata.

Tropical Africa. British East Africa: banks of the Guaso Nyiro River, *Hutchins;* at 1830-1980 m., *Battiscombe* 29.

1618. **Salix Murielii,** *Skan* [Salicaceae]; *S. nigericae,* Skan, affinis, sed foliis saepe latioribus etiam adultis majus griseo-pubescentibus, stylo nullo differt.

Ramuli teretes, juniores dense griseo-villosi, demum glabri et brunnei. *Folia* ovato-lanceolata vel late lanceolata, apice acuta vel acuminata, basi rotundata vel leviter cuneata vel interdum paulum cordata, integra, 3·5-7 cm. longa, 1·3-2·5 cm. lata, utrinque etiam adulta plus minusve dense griseo-sericea; petiolus 2-7 mm. longus, dense breviterque griseo-villosus; stipulae oblique ovatae, 4-9 mm. longae, plus minusve glandulosodenticulatae, interdum supra papillis glandulosis instructae, interdum minutae vel 0. *Amenta* foliis coaetanea. *Amenta* ♂ cylindrica, 2·5-7 cm. longa, 7-8 mm. crassa, densiflora; rhachis villosa. *Pedunculus* ad 1·5 cm. longus, villosus, folia plura breviter petiolata obovata vel elliptica 1-1·5 cm. longa et 4-6 mm. lata apice rotundata et apiculata vel acuta ferens. *Bracteae* ellipticae, obovatae vel ovatae, 2-3 mm. longae, 1·5-2 mm. latae, apice obtusae vel rotundatae, pilis albis lanatis dense tectae. *Glandulae disci* fere ad 1 mm. longae, latae et complanatae, integrae, dentatae vel profunde lobatae. *Stamina* 6-12; filamenta inferne dense lanata. *Amenta* ♀ fructifera 3·5-5 cm.

longa; rhachis villosa. *Pedunculus* 1·5-3 cm. longus, folia plura elliptico-lanceolata apiculata ad 3 cm. longa et 1·5 cm. lata ferens. *Bracteae* ellipticae, 3 mm. longae, 1·5 mm. latae, obtusae, dense villosae, cito deciduae. *Glandulae disci* poculum irregulare dentatum vel lobatum quadranti vel dimidio pedicelli quem cingit aequilongum formantes. *Pedicellus* 1-1·5 mm. longus, villosus. *Capsula* late ovoidea, 4-6 mm. longa, 2·5-3·75 mm. lata, glabra vel interdum sat dense villosa; stylus nullus; stigmata parva, leviter lobata.—*S. Safsaf*, Forsk., var. *hirta*, Anders. in Vet.-Akad. Handl. Stockh. vol. vi. (1867) no. 1, p. 12, and in DC. Prodr. vol. xvi. pars ii. p. 197.

Tropical Africa. Nile Land: without precise locality, *Sabbatier*. Nubia; near Khartoum, *Schweinfurth* 866; between Berber and Khartoum, *Schweinfurth* 611. Sennar; common on the Blue Nile, *Muriel* S18, S19; north of the mouth of the River Dinder, *Brown*.

1619. **Salix nigerica,** *Skan* [Salicaceae]; *S. Chevalieri*, Seemen, proxima, sed foliis haud vel tantum leviter reticulatis et capsula breviore late ovoidea distinguenda.

Ramuli teretes, juniores sericeo-pubescentes, demum rubro-brunnei et glabri. *Folia* lanceolata, apice acuta vel acuminata, basi rotundata vel cuneata, remote minuteque serrulata vel integra, 3·5-7 cm. longa, 7-18 mm. lata, juniora plus minusve sericeo-pubescentia, demum glabra et coriacea; petiolus 2-5 mm. longus, puberulus vel glaber; stipulae desunt. *Amenta* foliis coaetanea; rhachis dense villosa. *Pedunculus* 1-2 cm. longus, villosus, folia pauca elliptico-lanceolata breviter petiolata apice rotundata vel apiculata 6-18 mm. longa 3-8 mm. lata plus minusve sericeo-pubescentia ferens. *Amenta* ♂ cylindrica, 1-3·5 cm. longa, 5-6 mm. lata, densiflora. *Bracteae* suborbiculares vel obovatae, fere 2 mm. longae, 1·5 mm. latae, apice rotundatae, villosae. *Glandulae disci* anticae, subcylindricae, fere ad 1 mm. longae. *Stamina* ad 11 vel plura; filamenta inferne dense villosa. *Amenta* ♀ fructifera ad 3 cm. longa. *Bractae* eis amentorum ♂ simillimae, cito deciduae. *Glandulae disci* poculum lobatum pedicellum cingens eique fere aequilongum formantes. *Pedicillus* vix 1 mm. longus, villosus. *Capsula* late ovoidea, 5-6 mm. longa, 3-3·5 mm. lata, minute lepidota, interdum parce sericeo-pubescens; stylus fere ·5 mm. longus; stigmata 2-lobata.

Tropical Africa. Northern Nigeria: Katagum District; on banks of streams, *Dalziel* 220. Lake Chad to Bornu, *Talbot* 1493.

Dalziel's no. 199, from the banks of the Benue River at Yola, has male catkins only, and these are more slender than those of his no. 220 and have narrower sparingly woolly or nearly glabrous bracts, while the flowers have only 5 to 8 stamens. The leaves present on the short catkin-bearing branchlets are narrower and longer. It is possibly a distinct species, but the material is inadequate for a complete description. Its Hausa name is "ba ruana."

1620. **Salix Schweinfurthii,** *Skan* [Salicaceae]; *S. Murielii,* Skan, proxima, sed foliis oblongo-lanceolatis longe acuminatis ad 12 cm. longis, amentis fructiferis ad 6 cm. longis, capsula distincte rostrata differt.

Ramuli primo dense griseo-tomentosi, denum brunnei et glabri. *Folia* petiolata, oblongo-lanceolata, longe acuminata, basi rotundata, serrulata, ad 12 cm. longa, 2·5-4 cm. lata, primo utrinque dense villosa, demum glabrescentia, sat tenuia; costa conspicua, supra plana, infra elevata; nervi laterales numerosi, conspicui sed tenues; petiolus 8-14 mm. longus, plus minusve villosus vel glabrescens; stipulae semicordatae, rotundatae vel acutae, 4-16 mm. longae, glanduloso-denticulatae et interdum glandulis prominentibus ad ambas superficies praeditae. *Amenta* ♂ desunt. *Amenta* ♀ fructifera pedunculata, 2·5-6 cm. longa; rhachis villosa. *Pedunculus* villosus, 1-2·5 cm. longus, folia pauca lanceolata 1·5-3·5 cm. longa et 4-12 mm. lata ferens. *Bracteae* desunt. *Glandulae disci* ·5-·75 mm. longae, poculum irregulariter lobatum formantes. *Pedicellus* fere 2 mm. longus, glaber. *Capsula* ovoidea, supra medium in rostrum contracta, 4-5 mm. longa, circiter medium 2·5-2·75 mm. lata, glabra; stigmata subsessilia, brevissime 2-lobata.

Tropical Africa. Nubia: Khartoum, *Schweinfurth* 879. Kordofan, *Kotschy* 439.

Kotschy's no. 436, also from Kordofan, probably belongs to this species, but differs in having much smaller leaves. Like his no. 439 it bears no catkins.

Solms (in Schweinf. Beitr. Fl. Aethiop. p. 187) mentioned under the name of *Salix nilicola* a willow with long acute toothed leaves and very long catkins, of which specimens were collected by Ehrenberg in Dongola. It is possible that it is the same as *S. Schweinfurthii.*

XXVI.—MISCELLANEOUS NOTES.

Woody Vegetation and the Winter of 1916-17.—Looking over the collections of trees and shrubs at Kew, with recollections of last winter still vividly in mind—its seemingly interminable character and the severity of the cold on several occasions—the predominant feeling is one of surprise that so little real or permanent damage was done. A long series of mild or moderate winters had encouraged venturesomeness on the part of the planter, and in many gardens plants have been put in the open ground which could only be expected to collapse when the first real test came. The Eucalyptuses are examples; and after last winter's experiences the only species that can at present be called really hardy at Kew are *E. Gunnii* (the Whittingehame form) and *E. vernicosa.* All the others were killed. Many species of Cistus, too, could only be regarded as existing in our grounds on sufferance. When the last snows of April went and spring had really come, we found that five sorts had survived. *C. cyprius* and *C. laurifolius* were scarcely damaged; of *C.*

corbariensis perhaps half had succumbed; and of *C. salvifolius* and *C. Loreti* sufficient living growth remained to preserve them for the collection.

But, on the whole, by August the damage is seen to be surprisingly small. The number of plants killed outright is not large, and most of those which were badly scarred four months ago have had their wounds concealed by new growths. At the present time (August) the collection of bamboos looks better and more luxuriant than it has done for some years, thanks of course to the abundant rainfall, but in May last these plants made the most depressing group in Kew. Only one species, *Arundinaria anceps*, was cut back to ground level.

It is a curious fact that European vegetation has shown ill effects from the winter almost more than that of any other of the great areas that supply our hardy trees and shrubs. In many places, common gorse has been killed to the ground. At Kew, *Anthyllis Hermanniae* was swept out except under shelter, although it had survived all the winters since 1895. Most of the plants of rosemary were killed and very few *Erica australis* survived. That species, however, we have always regarded as about the most tender of European heaths in cultivation. *Erica arborea*, *E. lusitanica* and *E. Veitchii*, all somewhat hardier than *E. australis*, suffered injury, especially *E. Veitchii*, of which most had to be dug up. Large breadths of *E. mediterranea* are grown at Kew and they were badly hit where the plants had become crowded and drawn up; but sturdy well-exposed plants came through with little injury. Of the Portuguese form of *Erica ciliaris* (*Maweana*) a large proportion died. Many old plants of *Daboecia polifolia* were irretrievably injured but young ones have recovered. *Arbutus Unedo* and *A. hybrida* were badly cut where the trees were fully exposed to the north-east. Our stock of *Cytisus albus* was very much damaged, and in connection with the same species it was curious to find that several seedlings of *C. Dallimorei*—a hybrid between *C. albus* and *C. Andreanus*—were killed outright, although four or five years old.

Whilst common gorse was so severely hit, *Ulex Gallii*, a species confined in this country to the south-western counties, and generally regarded as less hardy, was not affected. On walls, myrtles and the olive were injured, but that was only to be expected.

Seeing what happened to common gorse, it is curious to find the reputedly tender *Magnolia Campbellii* quite untouched and making splendid growth this summer. The same can also be said of another inhabitant of the Himalaya with a similar reputation, viz. *Buddleia Colvilei*, which, growing without protection out of doors, has flowered this summer. The new Chinese Magnolias showed no ill effects nor did the various members of such interesting genera as *Meliosma*, *Tapiscia*, *Styrax*, *Emmenopterys*, *Stewartia*, *Dipelta*, *Kolkwitzia*, *Evodia*, *Sargentodoxa* (near a wall), *Sinowilsonia*, *Fortunearia*, *Poliothyrsis* and *Sinofranchetia*. Nor were the young conifers of Wilson's and Forrest's introduction in anyway hurt. The only

barberry to show ill effects was *B. atrocarpa* (the *B. levis* of gardens), but it has quite recovered.

Some of the newer Rhododendrons of Forrest's introduction were killed, amongst them *R. bullatum* and a few unnamed species, but on the whole the Chinese species came through remarkably well. Except that the flower buds of many were destroyed and some of the more sappy growths cut back, they were so little affected that by July the great majority presented a normal appearance.

Much of the damage done to Ericaceae at Kew was caused by an exceedingly bitter north-east wind which swept across the place without intermission for about a week near the end of January. During this period of incessant wind the temperature rose only once a single degree above freezing point. Probably this black week did more harm than all the frosts, which can scarcely be regarded as of extraordinary severity. The lowest temperatures were recorded on Feb. 7, 8, and 9 when the minimum thermometer registered 22, 20, and 17 degrees of frost respectively.

One thing greatly in favour of hardy vegetation was the absence of the soft mild periods so characteristic of our winter seasons. In 1908-9 the mischief done was much greater, and it was due to the alternation of sharp frost and warm moist periods, the latter setting up growth only to be destroyed by a cold time following. Another thing to which has been due the healthy aspect of trees and shrubs generally since early summer was the absence of any late frosts. Growth was very late in starting and many plants were a month or six weeks behind their normal time in flowering. The high blossoming time of trees and shrubs consequently was a very short one, but, so far as leafy growth is concerned, once started they were never checked. To this also is due the fruiting of many trees and shrubs that very rarely reach that condition, owing to the destruction of the young fruits by late frosts. Kew lacked much of its characteristic charm during March and April, and one missed the familiar early flowers which in ordinary years belong to those months. But, on the whole, and in spite of the long cold winter, the year 1917 can be regarded as one very favourable to woody vegetation. W. J. B.

Zapupe.—Zapupe fibre came into prominence a little more than a decade ago, when in 1907 there were over 5,000,000 plants in various stages of growth in the State of Vera Cruz (see *K.B.* 1907, p. 397). Except for the botanical identity all the important information has been given in previous issues of the Bulletin (see 1906, p. 190; 1907, pp. 396-400; 1908, p. 268).

The three following cultivated species have been defined by Trelease, and good descriptions of the plants are given by Trelease and Berger:—

Agave Zapupe, *Trelease* in Trans. Acad. Sci. St. Louis, xviii. (1909), p. 32. t. i. (spines), t. ii. (panicle and bulbils); Berger, **Die Agaven (1915), p. 237.**

Blue Zapupe, Zapupe Azul, Zapupe de Estopier or Zapupe de San Bernardo of Tuxpan, Vera Cruz.

A. Lespinassei, *Trelease*, l.c. p. 33, t. i. (spines), t. iii. f. i. (parts of leaf); Berger, l.c. p. 256.

Zapupe de Tepezintla or Zapupe de Vincent of Juana, Ramirez and Tuxpan.

A. Deweyana, *Trelease*, l.c. p. 35, t. i. (spines), t. vi. (photograph of old panicles); Berger, l.c. p. 257.

The cultivated green Zapupe, Zapupe de Huasteca, Zapupe de Tantoyuca or Zapupe Verde of the region between Tampico and Vera Cruz.

None of these are known in the wild state; but Trelease distinguishes a fourth species, *A. aboriginum*, known in the region between Tampico and Vera Cruz as the wild Zapupe, Zapupe Cimarron, Zapupe silvestre, or Zapupe de Sierra Chontla; and this is said to be sometimes cultivated.

The herbarium material at Kew consists of spines only, from the Missouri Botanic Gardens. Flowers with the exception of those of *A. Zapupe*, do not appear to have been described by anyone, and the species have been distinguished chiefly on the characters of the leaves and spines. The latter are so well marked as to prevent any one species being mistaken for the other, and in general the plants, allowing for the slightly narrower leaves with the prickles on the edges, closely resemble Sisal Hemp (*Agave sisalana*).

In 1909 it was reported that the planting and cultivation of Zapupe continued to attract much attention, and several plantations three years old were cleaning and exporting fibre.[1] By 1910 several companies had been formed for the cultivation, in addition to the planting done by private individuals.[2] In 1911 a Belgian Syndicate made arrangements for the development of this fibre plant in the Vera Cruz district.[3] Finally, however, it was reported that in 1913 the cultivation had ceased and no fibre had been exported during the year.[4]

Small plants of *A. Zapupe* and *A. Deweyana* are in the collection of living plants at Kew.

A sample of Zapupe fibre (species indefinite) in the Museum, originally from Mexico, was valued in London, 1913, at £30 to £32 per ton, with Sisal Hemp in the same year realising up to £35 per ton. The latter fibre it may be of interest to note is quoted (June, 1917) at £80 per ton, nominal value.

It would seem to be advisable therefore for those Colonies where the conditions are suitable for *Agave* cultivation to confine their attention to the better known Sisal Hemp, over which, notwithstanding early recommendations, Zapupe apparently possesses no advantage. J. H. H.

[1] Dip. and Cons. Rep. 4453, 1910, p. 5, Tampico.
[2] l.c. 4665, 1911, p. 9, Vera Cruz.
[3] l.c. 4873, 1912, p. 9.
[4] l.c. 5365, 1914, p. 15, Tuxpan, Vera Cruz.